

PATENT ABSTRACTS OF JAPAN

(11)Publication number : 2000-259695

(43)Date of publication of application : 22.09.2000

(51)Int.Cl.

G06F 17/50
H01L 21/82
H01L 21/3205

(21)Application number : 11-062396

(71)Applicant : NEC CORP

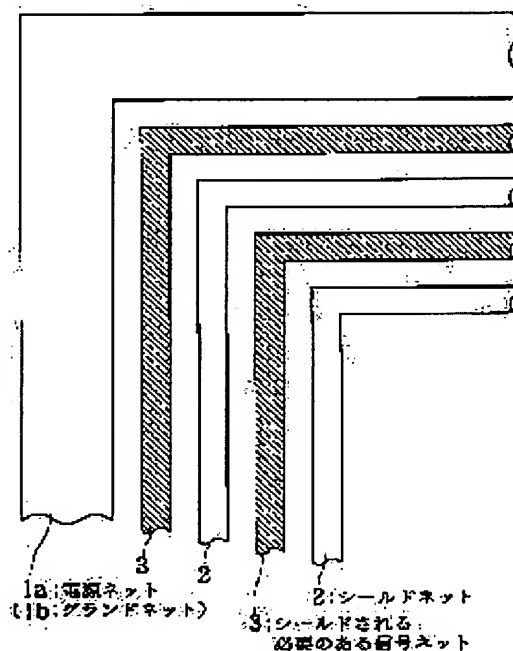
(22)Date of filing : 09.03.1999

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(54) SEMICONDUCTOR DEVICE, METHOD AND DEVICE FOR AUTOMATIC WIRING AND COMPUTER READABLE RECORDING MEDIUM STORING AUTOMATIC WIRING PROGRAM**(57)Abstract:**

PROBLEM TO BE SOLVED: To remove useless shield wiring and to improve the degree of integration (reduction of a chip size).

SOLUTION: When a power supply net 1a for an existing wiring, a ground net 1b or a shield net 2 for the existing wiring (hereinafter referred to as the power supply nets 1a, 1b, 2 of the existing wiring) in the case of searching the wiring route of a signal net 3 required to be shielded by a method for automatically wiring the signal net 3 and the shield net 2, the wiring route is searched so that the signal net 3 to be searched is arranged adjacently to the power supply nets 1a, 1b, 2 of the existing wiring, in a state securing prescribed clearance, and when the search of the adjacent route succeeds, the power supply nets 1a, 1b, 2 of the existing line are utilized as shield nets for shielding the signal net 3.

**LEGAL STATUS**

[Date of request for examination]

01.03.2000

[Date of sending the examiner's decision of rejection]

[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]

[Date of final disposal for application]

[Patent number]

3309825

[Date of registration]

24.05.2002

[Number of appeal against examiner's decision of rejection]

[Date of requesting appeal against examiner's decision of rejection]

[Date of extinction of right]

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CLAIMS

[Claim(s)]

[Claim 1] The semiconductor device are a semiconductor device equipped with the shielding network for shielding a signal network with the need of shielding, and said signal network, and carry out that insertion wiring of the share shielding network for shielding both these two signal networks between said two signal networks of the arbitration which approaches mutually and meets is carried out as the description.

[Claim 2] When searching for the wiring path of a signal network with the need of shielding and determining the wiring path of the signal network concerned, on one side or the both sides of the signal network concerned and where predetermined path clearance is secured It is the automatic wiring approach of wiring the shielding network for shielding the signal network concerned. In case it searches for the wiring path of a signal network with the need of shielding, when wired a power net or a grand network exists First, so that the signal network concerned may serve as a mode which adjoins wired a power net or a grand network where predetermined path clearance is secured It is the automatic wiring approach characterized by using wired said power net or a grand network as said shielding network for shielding the signal network concerned when it searches for a wiring path and succeeds in contiguity wiring with said wired power net or a grand network.

[Claim 3] In case it searches for the wiring path of a signal network with the need of shielding, when a wired power net, a grand network, or said wired shielding network exists First, so that the signal network concerned may serve as a mode which adjoins a wired power net, a grand network, or said wired shielding network where predetermined path clearance is secured When it searches for a wiring path and succeeds in contiguity wiring with a wired power net, a grand network, or said wired shielding network The automatic wiring approach according to claim 2 characterized by using a wired power net, a grand network, or said wired shielding network as said shielding network for shielding the signal network concerned.

[Claim 4] The automatic wiring approach according to claim 2 or 3 of carrying out setting up low than the cost of other wiring grids the cost of said wiring grid near the network wired [said], and searching the minimum cost wiring path of a signal network with the need concerned of shielding if the wiring grid near said wired power net, a grand network, and/or said wired shielding network is the passage authorization grid which can pass the signal network for retrieval as the description.

[Claim 5] In searching for the wiring path of a signal network with the need of shielding first, the signal network concerned for retrieval about the ability of the wiring grid which adjoins or approaches wired said power net, a grand network, and/or said shielding network to be passed While determining in consideration of the path clearance between the signal network concerned, said wired power net and a grand network, and/or said wired shielding network About the ability of the wiring grid to which the signal network concerned for retrieval adjoins or approaches other wired signal networks to be passed The wiring width of face of the shielding network for shielding the signal network concerned, the 1st path clearance between this shielding network, and a signal network besides the wired above, And it determines in consideration of the 2nd path clearance between the signal networks concerned with the need of shielding with this shielding network. then, about wiring grids other than the passage prohibition grid determined that it cannot pass the signal network concerned for retrieval The automatic wiring approach according to claim 4 characterized by being low in the cost of the wiring grid near said wired power net, a grand network, and/or said wired shielding network, setting up the cost of other wiring grids highly, and searching for the minimum cost wiring path of the signal network concerned.

[Claim 6] In searching for the wiring path of a signal network with the need of shielding The wiring grid which adjoins or approaches wired said power net, a grand network, or said shielding network When it is in a field required in order to secure the path clearance between the signal network concerned for retrieval, said

wired power net and a grand network, or said wired shielding network These wiring grids are dealt with as a passage prohibition grid which cannot pass the signal network concerned for retrieval. The wiring width of face of the shielding network of a shielding [the wiring grid which adjoins or approaches other wired signal networks]-signal network concerned for retrieval sake, The 1st path clearance between this shielding network, and a signal network besides the wired above, And when it is in a field required in order to secure the 2nd path clearance between this shielding network and the signal network concerned which is going to wire The automatic wiring approach according to claim 5 characterized by dealing with these wiring grids as a passage prohibition grid which cannot pass the signal network concerned for retrieval.

[Claim 7] After determining the wiring path of a signal network with the need of shielding, on one side or the both sides of the signal network concerned When said power net wired [which adjoins or approaches the signal network concerned], a grand network, or said wired shielding network exists The ** which does not wire the new shielding network for shielding the signal network concerned to one side or the both sides of the signal network concerned, While using said wired power net, a grand network, or said wired shielding network as a shielding network for shielding the signal network concerned When said power net wired [which adjoins or approaches], a grand network, or said wired shielding network does not exist in the signal network concerned at one side or the both sides of the signal network concerned Even when the wiring grid of one side of the signal network concerned or both sides is said passage prohibition grid to the signal network concerned, on one side or the both sides of the signal network concerned and where predetermined path clearance is secured The automatic wiring approach according to claim 6 characterized by wiring the new shielding network for shielding the signal network concerned.

[Claim 8] When searching for the wiring path of a signal network with the need of shielding and determining the wiring path of the signal network concerned, on one side or the both sides of the signal network concerned and where predetermined path clearance is secured It is automatic wiring equipment which wires the shielding network for shielding the signal network concerned. In case it searches for the wiring path of a signal network with the need of shielding, when wired a power net or a grand network exists First, so that the signal network concerned may serve as a mode which adjoins wired a power net or a grand network where predetermined path clearance is secured When a signal network wiring means to search for a wiring path, and this signal network wiring means determine the wiring path of the signal network concerned, on one side or the both sides of the signal network concerned and where predetermined path clearance is secured A shielding network wiring means to wire the shielding network for shielding the signal network concerned, When said signal network wiring means succeeds in wiring wired said power net or a grand network adjacently in the signal network concerned where predetermined path clearance is secured The inside of the shielding network which should wire in order to control said shielding network wiring means and to shield the signal network concerned, Automatic wiring equipment characterized by coming to have the shielding wiring control means which makes wiring processing of a near shielding network in which wired said power net or a grand network exists omit.

[Claim 9] When searching for the wiring path of a signal network with the need that said signal network wiring means is shielded, When a wired power net, a grand network, or said wired shielding network exists First, so that the signal network concerned may serve as a mode which adjoins a wired power net, a grand network, or said wired shielding network where predetermined path clearance is secured It searches for a wiring path. And said shielding wiring control means When it succeeds in contiguity wiring with said wired power net, a grand network, or said wired shielding network The inside of the shielding network which should wire in order to control said shielding network wiring means and to shield the signal network concerned, Automatic wiring equipment according to claim 8 characterized by making wiring processing of a near shielding network in which said wired power net, a grand network, or said wired shielding network exists omit.

[Claim 10] If the wiring grid near said wired power net, a grand network, and/or said wired shielding network is a passage authorization grid which can pass the signal network for retrieval Said signal network wiring means is automatic wiring equipment according to claim 8 or 9 characterized by searching for the minimum cost wiring path of said signal network which sets up lower than the cost of other wiring grids the cost of said wiring grid near the network wired [said], and has the need of shielding.

[Claim 11] In searching for the wiring path of a signal network with the need that said signal network wiring means is shielded first, the signal network concerned for retrieval about the ability of the wiring grid which adjoins or approaches wired said power net, a grand network, and/or said shielding network to be passed While determining in consideration of the path clearance between the signal network concerned, said wired power net and a grand network, and/or said wired shielding network About the ability of the wiring grid to

which the signal network concerned for retrieval adjoins or approaches other wired signal networks to be passed The wiring width of face of the shielding network for shielding the signal network concerned, the 1st path clearance between this shielding network, and a signal network besides the wired above, And it determines in consideration of the 2nd path clearance between the signal networks concerned with the need of shielding with this shielding network. then, about wiring grids other than the passage prohibition grid determined that it cannot pass the signal network concerned for retrieval Automatic wiring equipment according to claim 10 characterized by being low in the cost of the wiring grid near said wired power net, a grand network, and/or said wired shielding network, setting up the cost of other wiring grids highly, and searching for the minimum cost wiring path of the signal network concerned.

[Claim 12] In searching for the wiring path of a signal network with the need that said signal network wiring means is shielded The wiring grid which adjoins or approaches wired said power net, a grand network, or said shielding network When it is in a field required in order to secure the path clearance between the signal network concerned for retrieval, said wired power net and a grand network, or said wired shielding network These wiring grids are dealt with as a passage prohibition grid which cannot pass the signal network concerned for retrieval. The wiring width of face of the shielding network of a shielding [the wiring grid which adjoins or approaches other wired signal networks]-signal network concerned for retrieval sake, The 1st path clearance between this shielding network, and a signal network besides the wired above, And when it is in a field required in order to secure the 2nd path clearance between this shielding network and the signal network concerned which is going to wire Automatic wiring equipment according to claim 11 characterized by dealing with these wiring grids as a passage prohibition grid which cannot pass the signal network concerned for retrieval.

[Claim 13] After determining the wiring path of a signal network with the need that said signal network wiring means is shielded, When the power net wired [which adjoins or approaches], a grand network, or said wired shielding network exists in the signal network concerned at one side or the both sides of the signal network concerned The ** which does not wire the new shielding network for shielding the signal network concerned to one side or the both sides of the signal network concerned, While using said wired power net, a grand network, or said wired shielding network as a shielding network for shielding the signal network concerned When said power net wired [which adjoins or approaches], a grand network, or said wired shielding network does not exist in the signal network concerned at one side or the both sides of the signal network concerned Even when the wiring grid of one side of the signal network concerned or both sides is said passage prohibition grid to the signal network concerned, on one side or the both sides of the signal network concerned and where predetermined path clearance is secured Automatic wiring equipment according to claim 12 characterized by wiring the new shielding network for shielding the signal network concerned.

[Claim 14] The record medium which recorded the automatic wiring program for making claim 1 thru/or any 1 of 13 realize the function of a publication on the computer and in which computer reading is possible.

[Translation done.]

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DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to the record medium which recorded the automatic wiring program on the automatic wiring approach for carrying out automatic wiring of a signal network and the shielding network on a semiconductor device and a semiconductor chip equipped with the shielding network for shielding a signal network, or a printed circuit board, and the automatic wiring equipment list and in which computer reading is possible.

[0002]

[Description of the Prior Art] In connection with detailed-izing and densification of an LSI process, it is the situation that the effect which the coupling capacity during a contiguity signal network increases, consequently a cross talk has on circuit reliability cannot be disregarded. In order to prevent this kind of cross talk, wiring and shielding a grand network and a power net on both sides of each [these] signal network, to a signal network with the need of protecting from the former the interference from the signal network in which it interferes to other signal networks, such as a clock network along which a signal with a high frequency passes, and other signal networks, is performed. However, although the computer (automatic wiring equipment) determined in the former the wiring path of signal networks with the need of shielding, such as a clock network, since people had determined the wiring path of shielding networks, such as a grand network and a power net, it had the fault of it having been complicated, and there having also been many misdelivery-of-mail lines, and requiring long duration by the completion of shielding wiring.

[0003] Then, JP,5-12383,A, JP,10-214899,A, etc. are provided with the shielding wiring path automatic searching method of a publication as a means to cancel this un-arranging. Wiring processing is performed by the following procedures in an automatic path searching method given in these official reports. The NAND gate currently first prepared for the library at a step SP 1 as shown in drawing 14 , After arranging the macro block of the multiplier designed using a primitive block (logical-function unit) and primitive block of the OR gate, a flip-flop, etc. to the contrant region set as the interior of a semiconductor chip, Networks with the need of shielding, such as a clock network, are extracted at a step SP 2. At a step SP 3 The path clearance between the wiring width of face of a network with the need of shielding, the wiring width of face of the network which shields this network, and a network with the need of shielding and the network to shield is harmonized, and it asks for imagination wiring width of face. A step SP 5 searches for an imagination wiring path by the imagination wiring width of face called for at a step SP 3 according to the minimum cost path heuristics. If an imagination wiring path is determined, an imagination wiring path will be developed at a step SP 6 with a network with the need of shielding, and the network to shield, and an actual wiring path will be acquired. Above-mentioned virtual wiring processing and expansion processing of virtual wiring are performed until wiring processing of all networks with the need of shielding is completed (steps SP4-SP6). If wiring processing of all networks with the need of shielding is completed (step SP 4), it will move to wiring processing of the remaining network without the need of shielding (step SP 7). Thus, since automatic wiring also of the network to shield is carried out according to the configuration given [above-mentioned] in an official report, it is not complicated and reduction-ization of the shortening and the man day of the wiring processing time can be attained.

[0004]

[Problem(s) to be Solved by the Invention] However, since imagination wiring width of face is decided uniformly and the wiring path is searched for from all networks with the need of shielding as mentioned above if it is in the conventional technique given [above-mentioned] in an official report, the wiring resource for a shielding network is surely needed for both sides to a network one each with the need of

shielding. For this reason, the chip area increased and there was a problem that integration was barred. by the way, to a network one each with the need of shielding, if the wiring resource for a shielding network is not surely secured to both sides, it learns, it is not *****, and it is possible also when it can omit. For example, although it may happen with the above-mentioned conventional technique also when a shielding wiring path as shown in drawing 15 is lengthened In this case, since the grand network 1 functions also as a shielding network 2 In order to shield each of the signal networks 3 and 3 of two by which the shielding network 2 of the next door of the grand network 1 is useless wiring, and contiguity wiring was carried out mutually Any one in the two shielding networks 2 and 2 which were inserted between the signal network 3 and 3 and which adjoin mutually is useless.

[0005] This invention was made in view of the above-mentioned situation, loses useless shielding wiring, and aims at offering the record medium which recorded the automatic wiring program on the semiconductor device, the automatic wiring approach, and automatic wiring equipment list which can aim at improvement in a degree of integration (miniaturization of a chip) and in which computer reading is possible.

[0006]

[Means for Solving the Problem] It is carrying out that insertion wiring of the share shielding network for shielding both these two signal networks is carried out between the two above-mentioned signal networks of arbitration which invention according to claim 1 requires for a semiconductor device equipped with the shielding network for shielding a signal network and the above-mentioned signal network with the need of shielding, approach mutually, and meet in order to solve the above-mentioned technical problem as the description.

[0007] And it is in the condition which secured predetermined path clearance. moreover -- if invention according to claim 2 searches for the wiring path of a signal network with the need of shielding and the wiring path of the signal network concerned is determined -- one side or the both sides of the signal network concerned -- The automatic wiring approach of wiring the shielding network for shielding the signal network concerned is started. In case it searches for the wiring path of a signal network with the need of shielding, when wired a power net or a grand network exists First, so that the signal network concerned may serve as a mode which adjoins wired a power net or a grand network where predetermined path clearance is secured When it searches for a wiring path and succeeds in contiguity wiring with the above-mentioned wired power net or a grand network, it is characterized by using wired the above-mentioned power net or a grand network as the above-mentioned shielding network for shielding the signal network concerned.

[0008] Moreover, invention according to claim 3 relates to the automatic wiring approach according to claim 2. In case it searches for the wiring path of a signal network with the need of shielding, when a wired power net, a grand network, or the above-mentioned wired shielding network exists First, so that the signal network concerned may serve as a mode which adjoins a wired power net, a grand network, or the above-mentioned wired shielding network where predetermined path clearance is secured When it searches for a wiring path and succeeds in contiguity wiring with a wired power net, a grand network, or the above-mentioned wired shielding network It is characterized by using a wired power net, a grand network, or the above-mentioned wired shielding network as the above-mentioned shielding network for shielding the signal network concerned.

[0009] Moreover, invention according to claim 4 relates to the automatic wiring approach according to claim 2 or 3. If the wiring grid near the above-mentioned wired power net, a grand network, and/or the above-mentioned wired shielding network is a passage authorization grid which can pass the signal network for retrieval It is characterized by setting up lower than the cost of other wiring grids the cost of the above-mentioned wiring grid near the network wired [above-mentioned], and searching for the minimum cost wiring path of a signal network with the need concerned of shielding.

[0010] Moreover, invention according to claim 5 relates to the automatic wiring approach according to claim 4. In searching for the wiring path of a signal network with the need of shielding first, the signal network concerned for retrieval about the ability of the wiring grid which adjoins or approaches wired the above-mentioned power net, a grand network, and/or the above-mentioned shielding network to be passed While determining in consideration of the path clearance between the signal network concerned, the above-mentioned wired power net and a grand network, and/or the above-mentioned wired shielding network About the ability of the wiring grid to which the signal network concerned for retrieval adjoins or approaches other wired signal networks to be passed The wiring width of face of the shielding network for shielding the signal network concerned, the 1st path clearance between this shielding network, and a signal network besides the wired above, And it determines in consideration of the 2nd path clearance between the signal networks concerned with the need of shielding with this shielding network. then, about wiring grids

other than the passage prohibition grid determined that it cannot pass the signal network concerned for retrieval. It is low in the cost of the wiring grid near the above-mentioned wired power net, a grand network, and/or the above-mentioned wired shielding network, and is characterized by setting up the cost of other wiring grids highly and searching for the minimum cost wiring path of the signal network concerned.

[0011] Moreover, invention according to claim 6 relates to the automatic wiring approach according to claim 5. In searching for the wiring path of a signal network with the need of shielding. The wiring grid which adjoins or approaches wired the above-mentioned power net, a grand network, or the above-mentioned shielding network. When it is in a field required in order to secure the path clearance between the signal network concerned for retrieval, the above-mentioned wired power net and a grand network, or the above-mentioned wired shielding network. These wiring grids are dealt with as a passage prohibition grid which cannot pass the signal network concerned for retrieval. The wiring width of face of the shielding network of a shielding [the wiring grid which adjoins or approaches other wired signal networks]-signal network concerned for retrieval sake, The 1st path clearance between this shielding network, and a signal network besides the wired above, And when it is in a field required in order to secure the 2nd path clearance between this shielding network and the signal network concerned which is going to wire, it is characterized by dealing with these wiring grids as a passage prohibition grid which cannot pass the signal network concerned for retrieval.

[0012] Moreover, invention according to claim 7 relates to the automatic wiring approach according to claim 6. After determining the wiring path of a signal network with the need of shielding, on one side or the both sides of the signal network concerned. When the power net wired [which adjoins or approaches the signal network concerned], a grand network, or the above-mentioned wired shielding network exists. The ** which does not wire the new shielding network for shielding the signal network concerned to one side or the both sides of the signal network concerned, While using the above-mentioned wired power net, a grand network, or the above-mentioned wired shielding network as a shielding network for shielding the signal network concerned. When the above-mentioned power net wired [which adjoins or approaches], a grand network, or the above-mentioned wired shielding network does not exist in the signal network concerned at one side or the both sides of the signal network concerned. Even when the wiring grid of one side of the signal network concerned or both sides is the above-mentioned passage prohibition grid to the signal network concerned, on one side or the both sides of the signal network concerned and where predetermined path clearance is secured. It is characterized by wiring the new shielding network for shielding the signal network concerned.

[0013] And it is in the condition which secured predetermined path clearance. moreover -- if invention according to claim 8 searches for the wiring path of a signal network with the need of shielding and the wiring path of the signal network concerned is determined -- one side or the both sides of the signal network concerned -- The automatic wiring equipment which wires the shielding network for shielding the signal network concerned is started. In case it searches for the wiring path of a signal network with the need of shielding, when wired a power net or a grand network exists. First, so that the signal network concerned may serve as a mode which adjoins wired a power net or a grand network where predetermined path clearance is secured. When a signal network wiring means to search for a wiring path, and this signal network wiring means determine the wiring path of the signal network concerned, on one side or the both sides of the signal network concerned and where predetermined path clearance is secured. A shielding network wiring means to wire the shielding network for shielding the signal network concerned, When the above-mentioned signal network wiring means succeeds in wiring wired the above-mentioned power net or a grand network adjacently in the signal network concerned where predetermined path clearance is secured. The inside of the shielding network which should wire in order to control the above-mentioned shielding network wiring means and to shield the signal network concerned, It is characterized by coming to have the shielding wiring control means which makes wiring processing of a near shielding network in which wired the above-mentioned power net or a grand network exists omit.

[0014] Invention according to claim 9 relates to automatic wiring equipment according to claim 8. Moreover, the above-mentioned signal network wiring means. In case it searches for the wiring path of a signal network with the need of shielding, when a wired power net, a grand network, or the above-mentioned wired shielding network exists. First, so that the signal network concerned may serve as a mode which adjoins a wired power net, a grand network, or the above-mentioned wired shielding network where predetermined path clearance is secured. It searches for a wiring path. And the above-mentioned shielding wiring control means. When it succeeds in contiguity wiring with the above-mentioned wired power net, a grand network, or the above-mentioned wired shielding network. The inside of the shielding network which

should wire in order to control the above-mentioned shielding network wiring means and to shield the signal network concerned, It is characterized by making wiring processing of a near shielding network in which the above-mentioned wired power net, a grand network, or the above-mentioned wired shielding network exists omit.

[0015] Moreover, invention according to claim 10 relates to automatic wiring equipment according to claim 8 or 9. If the wiring grid near the above-mentioned wired power net, a grand network, and/or the above-mentioned wired shielding network is a passage authorization grid which can pass the signal network for retrieval The above-mentioned signal network wiring means sets up lower than the cost of other wiring grids the cost of the wiring grid near the above-mentioned wired power net, a grand network, and/or the above-mentioned wired shielding network. It is characterized by searching for the minimum cost wiring path of the above-mentioned signal network with the need of shielding.

[0016] Invention according to claim 11 relates to automatic wiring equipment according to claim 10. Moreover, the above-mentioned signal network wiring means In searching for the wiring path of a signal network with the need of shielding first, the signal network concerned for retrieval about the ability of the wiring grid which adjoins or approaches wired the above-mentioned power net, a grand network, and/or the above-mentioned shielding network to be passed While determining in consideration of the path clearance between the signal network concerned, the above-mentioned wired power net and a grand network, and/or the above-mentioned wired shielding network About the ability of the wiring grid to which the signal network concerned for retrieval adjoins or approaches other wired signal networks to be passed The wiring width of face of the shielding network for shielding the signal network concerned, the 1st path clearance between this shielding network, and a signal network besides the wired above, And it determines in consideration of the 2nd path clearance between the signal networks concerned with the need of shielding with this shielding network. then, about wiring grids other than the passage prohibition grid determined that it cannot pass the signal network concerned for retrieval It is low in the cost of the wiring grid near the above-mentioned wired power net, a grand network, and/or the above-mentioned wired shielding network, and is characterized by setting up the cost of other wiring grids highly and searching for the minimum cost wiring path of the signal network concerned.

[0017] Invention according to claim 12 relates to automatic wiring equipment according to claim 11. Moreover, the above-mentioned signal network wiring means In searching for the wiring path of a signal network with the need of shielding The wiring grid which adjoins or approaches wired the above-mentioned power net, a grand network, or the above-mentioned shielding network When it is in a field required in order to secure the path clearance between the signal network concerned for retrieval, the above-mentioned wired power net and a grand network, or the above-mentioned wired shielding network These wiring grids are dealt with as a passage prohibition grid which cannot pass the signal network concerned for retrieval. The wiring width of face of the shielding network of a shielding [the wiring grid which adjoins or approaches other wired signal networks]-signal network concerned for retrieval sake, The 1st path clearance between this shielding network, and a signal network besides the wired above, And when it is in a field required in order to secure the 2nd path clearance between this shielding network and the signal network concerned which is going to wire, it is characterized by dealing with these wiring grids as a passage prohibition grid which cannot pass the signal network concerned for retrieval.

[0018] Invention according to claim 13 relates to automatic wiring equipment according to claim 12. Moreover, the above-mentioned signal network wiring means After determining the wiring path of a signal network with the need of shielding, on one side or the both sides of the signal network concerned When the above-mentioned power net wired [which adjoins or approaches the signal network concerned], a grand network, or the above-mentioned wired shielding network exists The ** which does not wire the new shielding network for shielding the signal network concerned to one side or the both sides of the signal network concerned, While using the above-mentioned wired power net, a grand network, or the above-mentioned wired shielding network as a shielding network for shielding the signal network concerned When the above-mentioned power net wired [which adjoins or approaches], a grand network, or a wired shielding network does not exist in the signal network concerned at one side or the both sides of the signal network concerned Even when the wiring grid of one side of the signal network concerned or both sides is the above-mentioned passage prohibition grid to the signal network concerned, on one side or the both sides of the signal network concerned and where predetermined path clearance is secured It is characterized by wiring the new shielding network for shielding the signal network concerned.

[0019] Invention according to claim 14 relates to the record medium in which computer reading is possible, and is characterized by recording the automatic wiring program for making claim 1 thru/or any 1 of 13

realize the function of a publication to a computer on this record medium further again.

[0020]

[Function] So that a signal network with the need of shielding may serve as a mode which adjoins where predetermined path clearance is secured to a wired power net, a grand network, and a shielding network according to the configuration of this invention When retrieval of a wiring path is performed and it succeeds in contiguity wiring with a wired power net, a grand network, and a shielding network Since the shielding network 2 wired [wired power-net 1a, grand network 1b, or] is used as a shielding network for shielding the signal network 3 concerned as shown in drawing 2 The futility that an unnecessary shielding network is wired in piles can be reduced, and, so, improvement in a degree of integration and the miniaturization of a chip can be expected. Moreover, speeding up of the part which can avoid useless shielding wiring processing, and automatic wiring processing can also be attained.

[0021]

[Embodiment of the Invention] Hereafter, the gestalt of implementation of this invention is explained with reference to a drawing. Explanation is concretely given using an example.

1st example drawing 1 the electric configuration of the automatic wiring equipment which is the 1st example of this invention <> An outline **** block diagram and drawing 2 The partial plugging chart and drawing 3 which show typically the description of the wiring path created by this automatic wiring equipment The flow chart and drawing 4 thru/or drawing 9 for explaining actuation (automatic wiring processing) of this example On drawing 4 for explaining actuation of this example, and a concrete target Drawing in which drawing 4 shows the arrangement (wiring) condition of a macro block, a power net, and a grand network, and drawing 5 In drawing expanding and showing the field of the circle A of drawing 4 , a wiring truck, drawing showing the established state of a wiring grid, drawing 6 , and drawing 7 In performing path planning, drawing showing the wiring path as which drawing for explaining the setting approach of the cost of a wiring grid and drawing 8 were determined by the minimum cost path heuristics in performing path planning, and drawing 9 are drawings for explaining the setting approach of the cost of a wiring grid. As the automatic wiring equipment 4 of this example is applied to the equipment which carries out automatic retrieval of the multilayer-interconnection path including the shielding wiring path of a semiconductor integrated circuit and it is shown in drawing 1 By the library 5 which stored the various graphic form information acquired by carrying out a layout design beforehand, the record medium 6 which recorded the automatic wiring (layout) program of this example, and the above-mentioned automatic wiring program control The processing unit 7 which performs automatic wiring processing of this example (body of a computer), The storage 8 equipped with the working area where the working area of this processing unit 7 is set up, and the data area various data required for processing and a processing result are remembered to be, The outline configuration is carried out from the indicating equipment 9 which displays artwork data, such as a detail plugging chart created by the processing unit 7, and the input units 10, such as a keyboard and a mouse. The above-mentioned record medium 6 may be a record medium of a magnetic disk, semiconductor memory, optical memory, and others.

[0022] The place where the automatic wiring program of this example differs from conventional it greatly In case it searches for the wiring path of a signal network with the need of shielding, as first shown in a processing unit 7 at drawing 2 When it is made to search for the wiring path which adjoins the shielding network 2 wired [wired power-net 1a, grand network 1b, or] preferentially and succeeds in contiguity wiring as a result of this retrieval It is the point that the procedure (function) of making wiring processing of the shielding network by the side of wired power-net 1a, grand network 1b, or the shielding network 2 omitting among the shielding networks 2 of one pair of right and left for shielding the signal network 3 is written in.

[0023] Next, actuation of this example is explained with reference to drawing 3 thru/or drawing 5 . As shown in drawing 3 , introduction and a circuit designer are step SQ1, use block graphic form information, terminal graphic form information, etc., such as a macro block of a primitive block of a flip-flop etc., a multiplier, etc. which were prepared for the library 5, and perform the circuit design by CAD. In addition, an above-mentioned block graphic form and an above-mentioned terminal graphic form are constituted from the rectangle graphic form with which the magnitude configuration location etc. was pinpointed, or its set by parameters, such as a "layer", a "lower left coordinate", and an "upper right coordinate." Next, a circuit designer memorizes the various above-mentioned information which created and (step SQ2) created a netlist (the initial entry between terminals, wiring width-of-face information), substrate information (grid size (wiring truck spacing), the number of wiring layers, etc.), wiring prohibition information, etc. to storage 8 by making into a wiring object domain the contrant region set as the interior of a semiconductor chip,

looking at the circuit diagram by which a screen display was carried out to the indicating equipment 9.

[0024] Next, as a circuit designer does a screen display of the contrant region of a semiconductor chip to an indicating equipment 9 and it is further shown in drawing 4 based on the substrate information created at step SQ2 in the contrant region of a semiconductor chip As Grids G and G and -- (the wiring trucks T and T, --) are displayed and it is shown in drawing 4 and drawing 5 with reference to the netlist and wiring prohibition information which were created at step SQ2 The macro block 11, power-source (Vdd) network 1a and grand network 1b, and the primitive block 12 are arranged to the contrant region of a semiconductor chip in this sequence (wiring) (step SQ3), and it memorizes to storage 8 by making an arrangement location and a wiring path into layout information. In addition, in this example, actual wiring of two or more straight-line-like power-net 1a and grand network 1b is carried out in the direction of a main shaft (the priority direction), respectively. If it is the multilayer-interconnection structure of three layers between contiguity wiring layers since the direction of a main shaft is made to intersect perpendicularly mutually for example, moreover, in the 1st layer and the 3rd layer Power-net 1a and grand network 1b are wired in the longitudinal direction in drawing 4 , and it wires in the 2nd layer in the lengthwise direction in drawing 4 , and Beer V and V and -- which were prepared by being punched and filled up connect with the interlayer insulation film mutually between each class.

[0025] Next, a circuit designer is step SQ4, extracts a signal network with the need of shielding, and memorizes an extract result to storage 8. The signal networks extracted are networks in which it interferes to other networks, such as a clock network along which a signal with a high frequency passes, and a network with the need of preventing the interference from other networks.

[0026] When extract processing of a signal network with the need of shielding is completed, a circuit designer supplies a power source to automatic wiring equipment 4, and makes automatic wiring processing start. If an instruction of processing initiation is given from an input unit 10, the automatic wiring program of this example will be read into a processing unit 7 from a record medium 6, and will control actuation of a processing unit 7 by automatic wiring equipment 4. A processing unit 7 performs the following processings about all the signal networks 3 with the need of shielding, using the netlist memorized by storage 8, substrate information, layout information, wiring prohibition information, etc. by automatic wiring program control (steps SQ5-SQ8).

[0027] A processing unit 7 sets each grids G and G in a wiring object domain (drawing 4 and drawing 5), and in order to take out one of the arbitration out of the signal network 3 with the need of shielding (step SQ5) and to search for the wiring path of this signal network 3 taken out (to beginning) using the minimum cost path heuristics, it sets cost as -- first (step SQ6). Here, middle cost is set as each beer V and V and -- which connect [cheap cost] between vertical wiring layers for high cost to the grids G and G of the direction of a countershaft, and -- again at the grids G and G of the direction of a main shaft, and --. The cost of infinity is set to a passage prohibition grid.

[0028] Although the above-mentioned cost setup is the same as that of it of the conventional technique, and abbreviation, in this example, cost is set up in the path planning of the signal network 3 taken out first in consideration of wired power-net 1a and grand network 1b. Namely, in order for the signal network 3 with the need of shielding to, adjoin power-net 1a and grand network 1b if possible and to make it wired, a processing unit 7 Grids G and G and -- which adjoin power-net 1a and grand network 1b When it is out of the path clearance C set up based on a spacing rule as long as the conditions of the path clearance C between power-net 1a (or grand network 1b) and the signal network 3 are fulfilled that is, As shown in drawing 6 (a), while setting Neighbors G and G and the cost of -- as "0", grids G and G other than a neighbor and the cost of -- are set as a bigger predetermined value than "0" according to an above-mentioned regulation. On the other hand, in order to avoid spacing rule violation as shown in drawing 7 (a) when Grids G and G and -- which adjoin or approach power-net 1a and grand network 1b are in the above-mentioned path clearance C, it considers as these grids G and G and the "passage prohibition grid" of -- which sets cost as infinity and cannot pass the signal network 3 for retrieval this time. In this case, the grids G and G besides path clearance C, the grids G and G nearest to inside and power-net 1a or grand network 1b of --, and the cost of -- are set as "0."

[0029] Although cost is set up in consideration of the path clearance C with the signal network 3 with the need of shielding, about the grids G and G power-net 1a and near the grand network 1b, and -- as described above On the other hand, keepout areas other than power-net 1a or grand network 1b About the grids G and G near for example, (the terminal, the keepout area within the macro block 11 or the primitive block 12, and having existing wired other than power-net 1a or grand network 1b), and -- The wiring width of face WS of the shielding network 2 for shielding the signal network 3 for retrieval this time Cost is set up in

consideration of the 1st path clearance C1 between keepout areas other than power-net 1a or grand network 1b (an existing plugging-chart form, a terminal graphic form, and prohibition graphic form), and the shielding network 2, and the 2nd path clearance C2 between the signal network 3 and the shielding network 2. That is, let processing units 7 be the grids G and G which are in distance (WS+C1+C2) from the edge of keepout areas other than power-net 1a or grand network 1b (an existing plugging-chart form, a terminal graphic form, and prohibition graphic form), and the "passage prohibition grid" of -- which sets cost as infinity and cannot pass the signal network 3 for retrieval this time.

[0030] If a setup of cost is completed, a processing unit 7 will progress to step SQ7, and will perform the minimum cost path planning from this. The lowest wiring path of total cost is followed in this path planning. So, as shown in drawing 6 (b) and drawing 7 (b), the grids G and G which adjoin or approach power-net 1a (or grand network 1b), and the path which passes along -- are determined as a wiring path of the signal network 3 for retrieval this time (when it says still more strictly, it is a right expression that possibility of being adopted as a wiring path becomes high.). Because, which wiring path is adopted by not restricting that the wiring path which adjoins or approaches power-net 1a (or grand network 1b) is surely found Wiring cost length, beer cost, and the cost of the grid which adjoins or approaches power-net 1a (or grand network 1b), It is because it may happen that the wiring path which balance with the cost of the other grid is taken into consideration, consequently bypasses power-net 1a (or grand network 1b) is adopted. If a wiring path is determined, it will wire this time by the actual wiring width of face of the signal network 3 for retrieval. For example, when it is the signal network 3 to which this candidate for retrieval connects between the terminal TA(1)-terminal TB (2) shown in drawing 5 , drawing 8 -- being shown -- as -- a terminal -- TA -- (-- one --) --> -- wiring -- a segment -- La -- (-- one --) --> -- beer -- V (1 2) --> -- wiring -- a segment -- Lb -- (-- two --) --> -- beer -- V (2 3) --> -- wiring -- a segment -- Lc -- (-- three --) --> -- beer -- V (3 2) --> -- wiring -- a segment -- Ld -- (-- two --) --> -- a terminal -- TB -- (-- two --) -- following -- a path -- determining -- having . The terminal and TB (2) which were prepared in the wiring layer of the 1st layer TA (1) here The terminal prepared in the wiring layer of the 2nd layer and La (1) The wiring segment prepared in the wiring layer of the 1st layer, Lb (2), and Ld (2) The wiring segment prepared in the wiring layer of the 2nd layer and Lc (3) A beer plug for the wiring segment and V (1 2) which were prepared in the wiring layer of the 3rd layer to connect the wiring segments of the 1st layer and the 2nd layer, and V (2 3) and V (3 2) express the beer plug for connecting the wiring segments of the 2nd layer and the 3rd layer.

[0031] Then, if a processing unit 7 is required in step SQ8, it wires the shielding network 2 for shielding the signal network 3 wired this time. For example, since power-net 1a or grand network 1b can function as a shielding network about the signal network 3 wired by power-net 1a or grand network 1b by adjoining or approaching as shown in drawing 6 (b) and drawing 7 (b), it is not necessary to newly wire a shielding network between the signal networks 3, power-net 1a, or grand network 1b which were wired this time. So, a processing unit 7 does not perform wiring processing of a new shielding network in this case. But since it adjoins or arranges [contiguity] at power-net 1a or grand network 1b only in consideration of path clearance with power-net 1a or grand network 1b, the signal network 3 for which it looked this time should not have room to insert a shielding network between power-net 1a (or grand network 1b) and the signal network 3, without breaking a spacing rule.

[0032] The signal network 3 wired this time On the other hand, keepout areas other than power-net 1a or grand network 1b When it adjoins or approaches for example, (the terminal, the keepout area within the macro block 11 or the primitive block 12, and having existing wired other than power-net 1a or grand network 1b) As shown in drawing 6 (b) and drawing 7 (b), the shielding network 2 is wired between the signal network 3 concerned and keepout areas other than power-net 1a or grand network 1b (an existing plugging-chart form, a terminal graphic form, and prohibition graphic form). In this case, as described above, the grids G and G which are in distance (WS+C1+C2) from the edge of keepout areas other than power-net 1a or grand network 1b (an existing plugging-chart form, a terminal graphic form, and prohibition graphic form), and the cost of -- are set as infinity. Since it considered as the "passage prohibition grid" (step SQ6), the resource for wiring the shielding network 2 should be secured.

[0033] A processing unit 7 takes out one of the arbitration to step SQ5 out of return and the signal network 3 by which shielding processing is not yet carried out. (the 2nd) In order to search for the wiring path of this taken-out signal network 3 using the minimum cost path heuristics, according to the above-mentioned Ruhr, cost is first set as each grids G and G in a wiring object domain (drawing 4 and drawing 5), and -- (step SQ6). However, in the path planning on and after this time, since wired the signal network 3 and the shielding network 2 are generated, a passage prohibition grid increases each time.

[0034] Moreover, in this example, in case it looks for the signal network 3 taken out 2nd henceforth, cost is

set up in consideration of the shielding network 2 wired [wired power-net 1a, grand network 1b, and]. Namely, in order for the signal network 3 with the need of shielding to, adjoin the shielding network 2 wired [power-net 1a, grand network 1b, or] if possible and to make it wired, a processing unit 7 Grids G and G and -- which adjoin power-net 1a, grand network 1b, and the shielding network 2 While setting Neighbors G and G and the cost of -- as "0" as shown in drawing 9 (a) as long as it is out of the path clearance C required between power-net 1a (grand network 1b or shielding network 2) and the signal network 3 Grids G and G other than a neighbor and the cost of -- are set as a bigger predetermined value than "0" according to an above-mentioned regulation. On the other hand, when Grids G and G and -- which adjoin or approach power-net 1a, grand network 1b, and the shielding network 2 are in the above-mentioned path clearance C, in order to avoid spacing rule violation, it considers as these grids G and G and the "passage prohibition grid" of -- which sets cost as infinity and cannot pass the signal network 3 for retrieval this time. In this case, the grids G and G besides path clearance C, inside and power-net 1a, grand network 1b or the grids G and G nearest to the shielding network 2 of --, and the cost of -- are set as "0."

[0035] If a setup of cost is completed, a processing unit 7 will progress to step SQ7, and will perform the minimum cost path planning about the signal network 3 for retrieval this time. The lowest wiring path of total cost is followed in this path planning. As shown in drawing 6 (b), drawing 7 (b), and drawing 9 (b), so, keepout areas other than power-net 1a or grand network 1b for example, a terminal and the keepout area within the macro block 11 or the primitive block 12 -- The grids G and G which adjoin or approach having existing wired other than power-net 1a or grand network 1b, and the path which passes along -- It is determined as a wiring path of the signal network 3 for retrieval this time (since it described above also in this case, it is a right expression that possibility of being adopted as a wiring path becomes high).

[0036] Then, if a processing unit 7 is required in step SQ8, it wires the shielding network 2 for shielding the signal network 3 wired this time. For example, as shown in drawing 6 (b), drawing 7 (b), drawing 9 (b), and drawing 2 About the signal network 3 wired by adjoining or approaching by the shielding network 2 wired [wired power-net 1a, grand network 1b, or] Since wired power-net 1a or grand network 1b can function as a shielding network, and the signal network 3 wired this time carries out a shielding network and the wired shielding network 2 can function It is not necessary to newly wire a shielding network between the signal network 3 concerned and power-net 1a (grand network 1b or wired shielding network 2). So, a processing unit 7 does not perform processing which wires a new shielding network in this case.

[0037] On the other hand, when the signal network 3 for which it looked this time protects a design rule next to it and shielding wiring of it can be carried out, as shown in drawing 6 (b), drawing 7 (b), drawing 9 (b), and drawing 2 , the signal network 3 for which it looked this time, and the shielding network 2 are wired.

[0038] A processing unit 7 is performed about all the signal networks 3 from which above-mentioned wiring processing and shielding processing (steps SQ5-SQ8) were extracted in step SQ4 (as a thing with the need of shielding). Processing is ended, when wiring processing and shielding processing were completed, and wiring processing of the remaining signal network without the need of a processing unit 7 progressing to step SQ9, and shielding is performed and it succeeds in wiring of all signal networks about all the extracted signal networks 3. However, processing is stopped when the signal network which cannot wire appears. In this case, a circuit designer increases the area of a semiconductor chip, or returns to step SQ3, rearranges the macro block 11 and the primitive block 12, and redoes above-mentioned processing.

[0039] Thus, since the shielding network 2 wired [wired power-net 1a, grand network 1b, or] is used as a shielding network of the signal network 3 wired this time according to the configuration of this example, the futility that an unnecessary shielding network is wired in piles can be reduced, and, so, the miniaturization of a semiconductor chip and improvement in a degree of integration can be expected. Moreover, speeding up of the part which can avoid useless shielding wiring processing, and automatic wiring processing can also be attained.

[0040] <> Explain the 2nd example, next the 2nd example of this invention. Drawing 10 is a flow chart for explaining actuation (automatic wiring processing) of the 2nd example of this invention. The place where this 2nd example differs from the 1st above-mentioned example greatly is the point of having investigated the amount of noises, and the delay value about all the signal networks that started the cross talk check program (step SQ10 of drawing 10), and succeeded in wiring, when it succeeds in wiring of all signal networks (step SQ9 of drawing 3). wiring of all the signal networks 3 that the circuit designer extracted as a signal network which has the need of shielding when the dangerous signal network 3 exists as a result of this cross talk check (step SQ11), and were extracted -- lengthening -- removing (step SQ12) -- the signal network data lengthened and removed are memorized to storage 8.

[0041] When a signal network with the need of shielding lengthens, it removes and processing is completed,

a circuit designer supplies a power source to automatic wiring equipment 4, and makes automatic wiring processing start. If an instruction of processing initiation is given from an input unit 10, the automatic wiring program of this example will be read into a processing unit 7 from a record medium 6, and will control actuation of a processing unit 7 by automatic wiring equipment 4. The same processing as abbreviation [described / while using the netlist memorized by storage 8, substrate information, layout information, wiring prohibition information, etc. / the processing unit 7 / above / about all the signal networks 3 with the need of shielding /, by automatic wiring program control, / in the 1st example] is performed (steps SQ13-SQ16).

[0042] In order to search for the wiring path of the signal network 3 which took out one of the arbitration (step SQ13), and was taken out using the minimum cost path heuristics out of the signal network 3 with the need of shielding, a processing unit 7 First, in consideration of the shielding network 2 wired [wired power-net 1a, grand network 1b and], cost is set up about each grids G and G in a wiring object domain (drawing 4 and drawing 5), and -- (step SQ14). However, this 2nd example lengthens, it removes and the signal network (usually henceforth the signal network 13) which is not shielded is also existing-wired in rewiring processing. So, although a processing unit 7 sets up cost in consideration of the path clearance C with the signal network 3 which has the need of shielding, like abbreviation [described / the 1st example] about the grids G and G power-net 1a and near the grand network 1b, and -- usually, about the about 13 signal network grids G and G and -- In consideration of the 1st path clearance C1 between the signal network 13 and the shielding network 2, and the 2nd path clearance C2 between the signal network 3 and the shielding network 2, cost is usually set up with the wiring width of face WS of the shielding network 2 for shielding the signal network 3 for retrieval this time. Namely, Grids G and G and -- which adjoin power-net 1a, grand network 1b, and the shielding network 2 a processing unit 7 If it is out of the path clearance C required between power-net 1a (grand network 1b or shielding network 2) and the signal network 3 As shown in drawing 11 (a) and drawing 12 (a), while setting these neighbors G and G and the cost of -- as "0" Usually, if Grids G and G and -- which adjoin the signal network 13, a terminal graphic form, and a prohibition graphic form (contiguity) are usually in distance (WS+C1+C2) from the edge of the signal network 13 It considers as these contiguity (contiguity) grids G and G and the "passage prohibition grid" of -- which sets cost as infinity and cannot pass the signal network 3 for retrieval this time.

[0043] If a setup of cost is completed, a processing unit 7 will progress to step SQ15, and will perform the minimum cost path planning about the signal network 3 for retrieval this time. The lowest wiring path of total cost is followed in this path planning. So, as shown in drawing 11 (b) and drawing 12 (b), the grids G and G which adjoin or approach power-net 1a (grand network 1b or shielding network 2), and the path which passes along -- are determined as a wiring path of the signal network 3 for retrieval this time. If a wiring path is determined, it will wire this time by the actual wiring width of face of the signal network 3 for retrieval.

[0044] Then, if a processing unit 7 is required in step SQ16, it wires the shielding network 2 for shielding the signal network 3 wired this time. As shown in drawing 11 (b) and drawing 12 (b), for example, wired power-net 1a, About the signal network 3 wired by adjoining or approaching by the shielding network 2 wired [grand network 1b or] Since wired power-net 1a or grand network 1b can function as a shielding network, and the signal network 3 wired this time carries out a shielding network and the wired shielding network 2 can function It is not necessary to newly wire a shielding network between the signal network 3 for which it looked this time, and power-net 1a (grand network 1b or wired shielding network 2). So, a processing unit 7 does not perform processing which wires a new shielding network in this case.

[0045] On the other hand, if shielding wiring of the signal network 3 for which it looked this time can be carried out, as shown in drawing 11 (b) and drawing 12 (b), it will usually wire the shielding network 2 between the signal networks 13 with the signal network 3 with which it was searched this time. In this case, as described above, the resource for wiring this shielding network 2, since cost was set as infinity and it considered as the "passage prohibition grid" (step SQ14) of the grids G and G in distance (WS+C1+C2) and -- is usually secured from the edge of the signal network 13.

[0046] A processing unit 7 performs above-mentioned rewiring processing and shielding processing (steps SQ13-SQ16) in step SQ12 about all the signal networks 3 that drew wiring and were removed. If the signal network which ends processing (step SQ17), performs cross talk check processing again, and has the need of shielding still exists when it succeeds in rewiring of all the signal networks 3 and shielding processing which were lengthened and removed, the procedure of drawing 10 will be repeated again. On the other hand, processing is stopped when the signal network which cannot wire appears in process of this processing. In this case, a circuit designer increases the area of a semiconductor chip, or returns to step SQ3, rearranges the

macro block 11 and the primitive block¹¹ 12, and redoes above-mentioned processing.

[0047] Thus, according to the configuration of this example, improvement in the precision of an extract of a signal network with the need of being able to acquire the same effectiveness as abbreviation [described / the 1st example], in addition shielding can be aimed at.

[0048] As mentioned above, although the example of this invention has been explained in full detail with the drawing, a concrete configuration is not restricted to this example, and even if there is modification of a design of the range which does not deviate from the summary of this invention etc., it is included in this invention. For example, this invention is applicable not only to a semiconductor chip but a printed circuit board. Moreover, although the above-mentioned example described the case where contiguity wiring of the signal network with the need of shielding was made to be carried out at a wired shielding network, a power net, and a grand network, one of the networks of these or two may be omitted if needed.

[0049] Moreover, a shielding network is not necessarily indispensable to the both sides of a signal network, and the shielding network of one side can be omitted if needed. Moreover, as shown in drawing 13 , when insertion arrangement of the signal network 3 with the need of shielding is carried out between power-net 1a and grand network 1b, the shielding network of dedication can be omitted completely.

[0050]

[Effect of the Invention] Since a wired power net, a grand network, or a wired shielding network is used as a shielding network of the signal network wired this time according to the configuration of this invention as explained above, the futility that an unnecessary shielding network is wired in piles can be reduced, and, so, the miniaturization of a semiconductor chip and improvement in a degree of integration can be expected. Moreover, speeding up of the part which can avoid useless shielding wiring processing, and automatic wiring processing can also be attained.

[Translation done.]

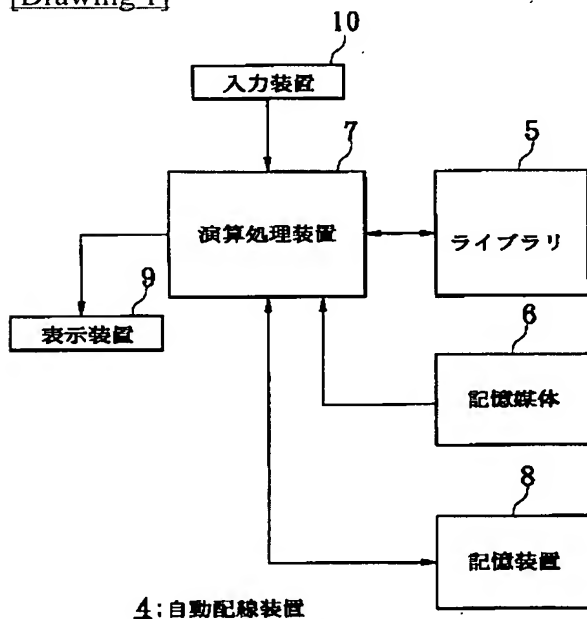
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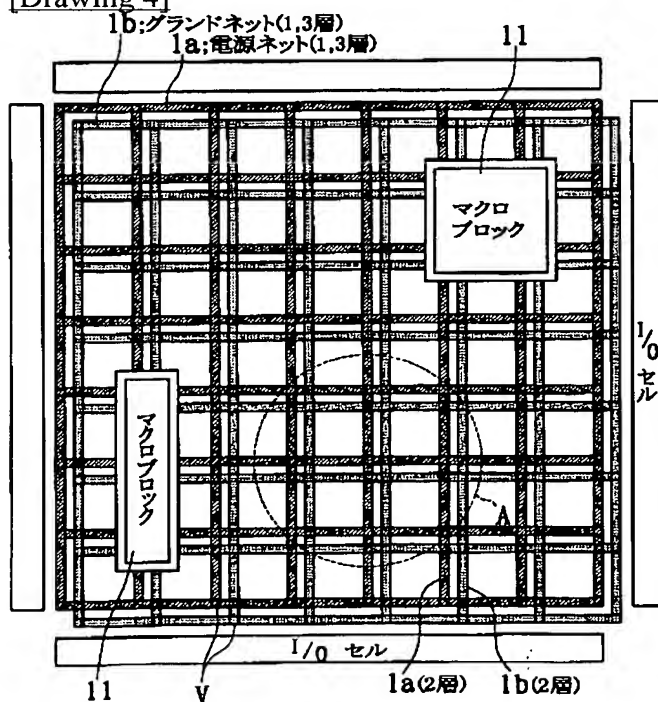
- 1.This document has been translated by computer. So the translation may not reflect the original precisely.
- 2.*** shows the word which can not be translated.
- 3.In the drawings, any words are not translated.

DRAWINGS

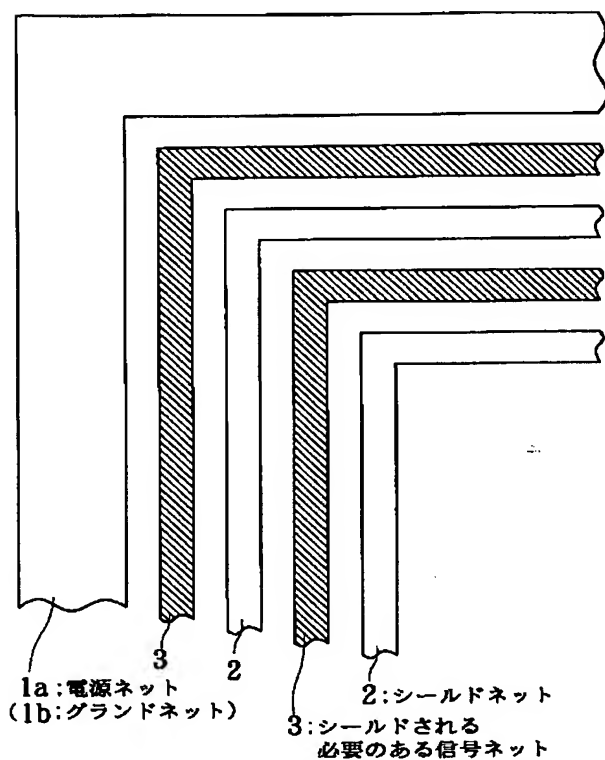
[Drawing 1]



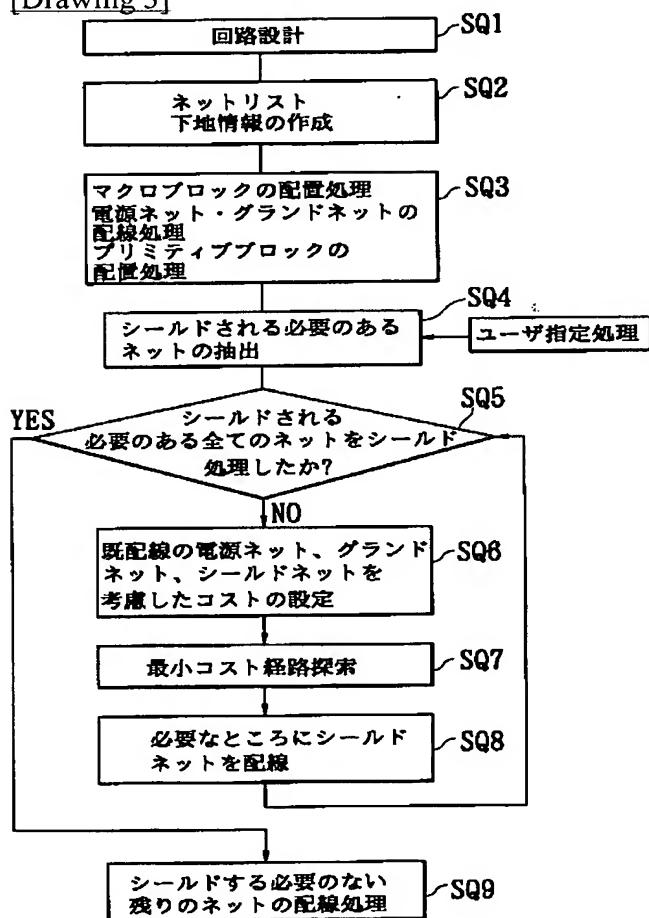
[Drawing 4]



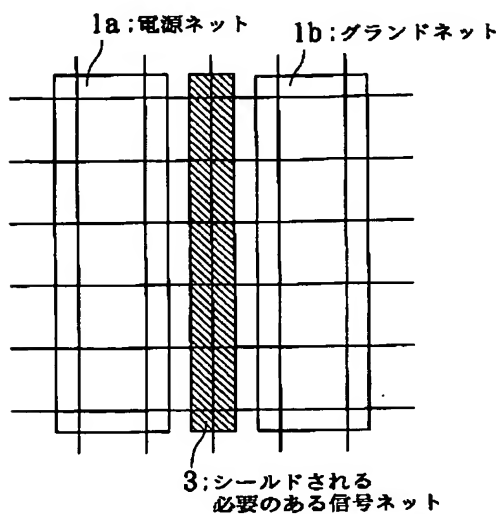
[Drawing 2]



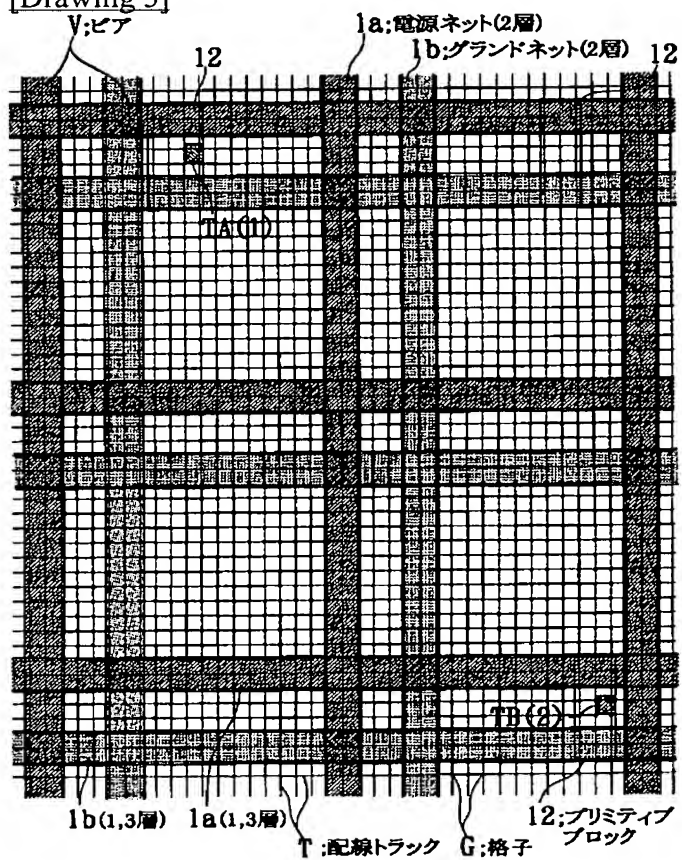
[Drawing 3]



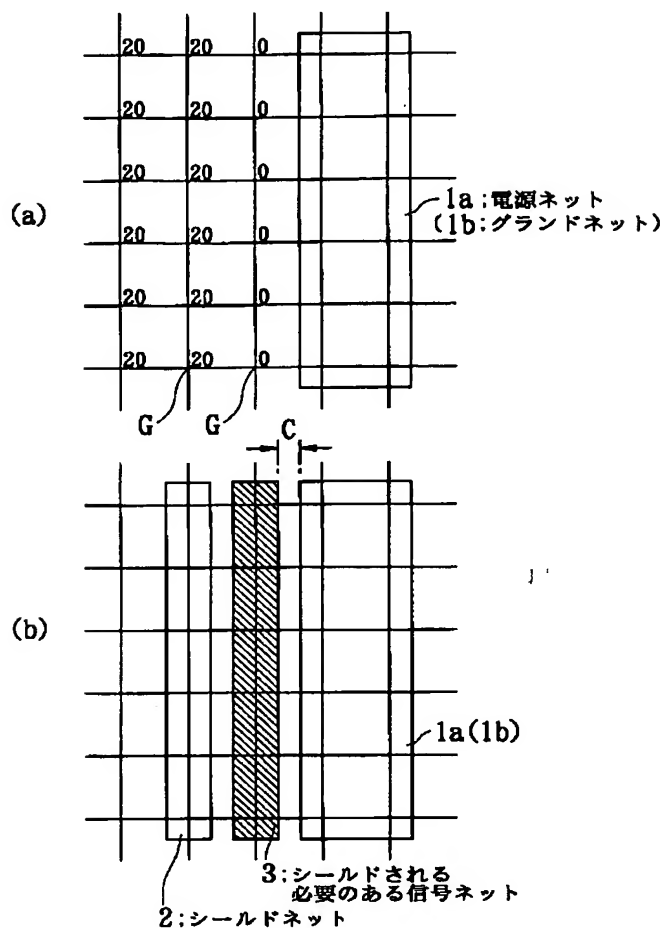
[Drawing 13]



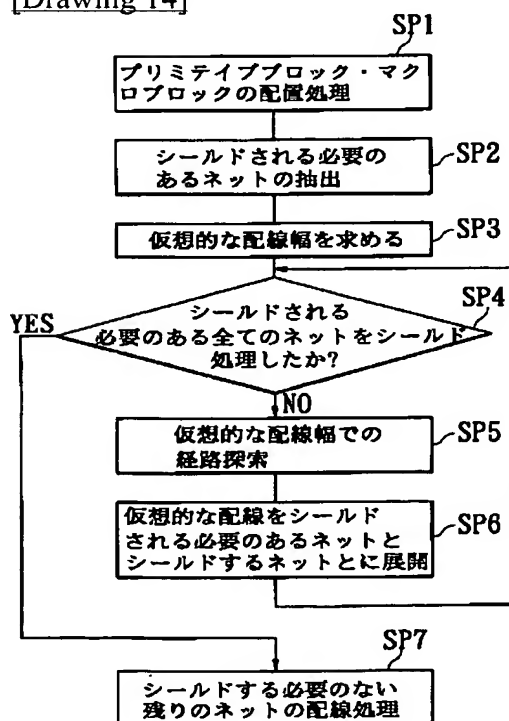
[Drawing 5]



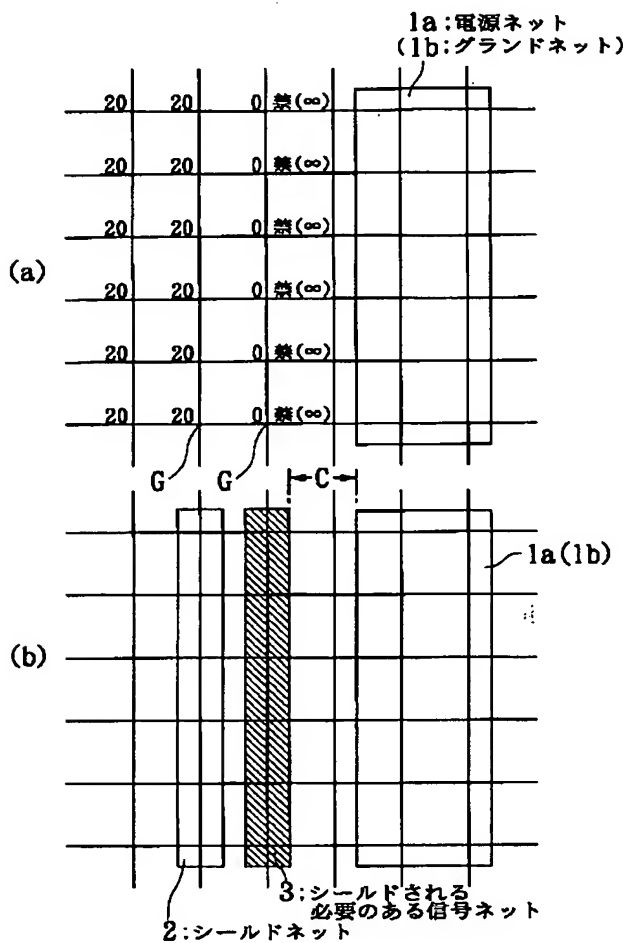
[Drawing 6]



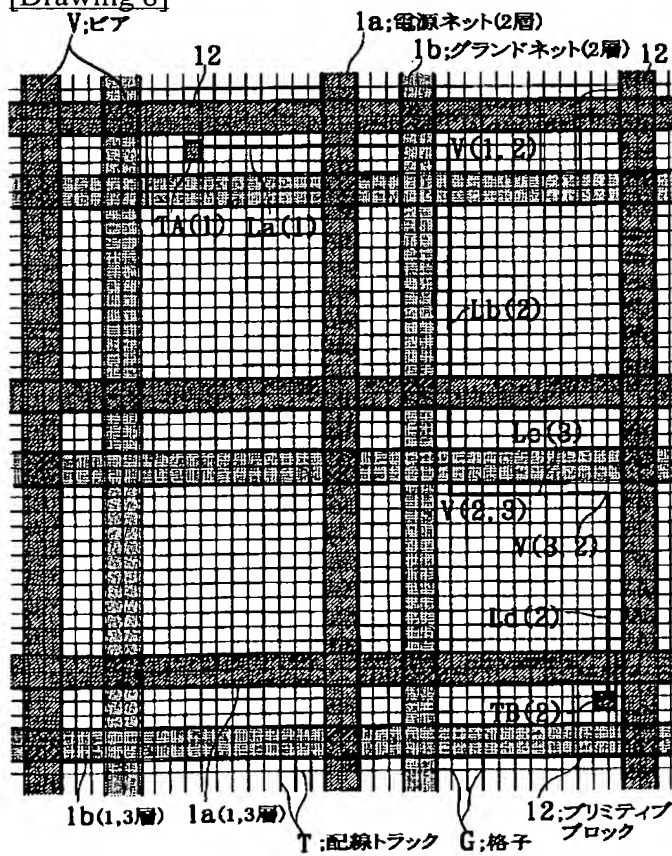
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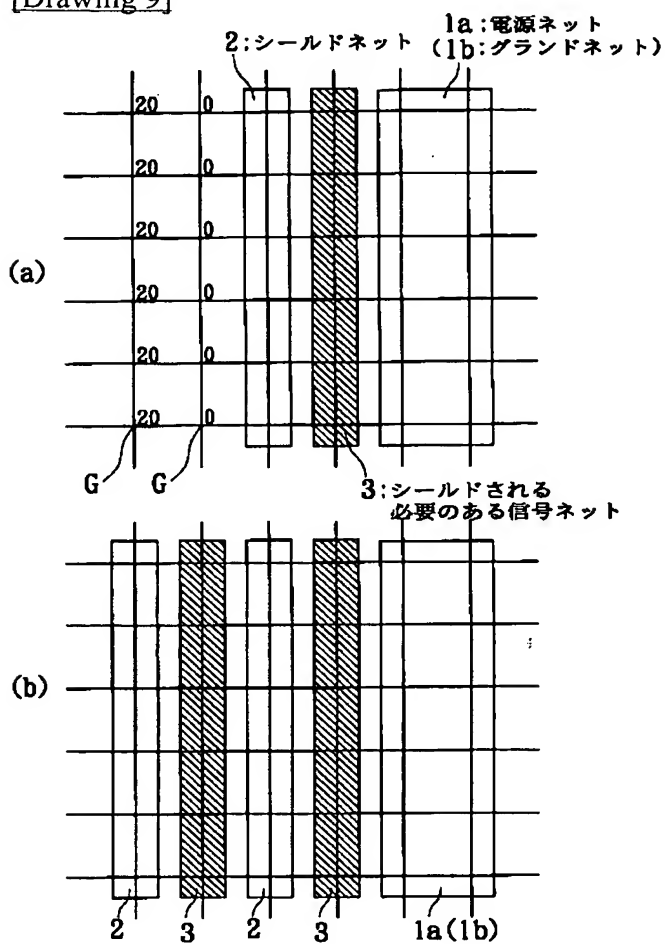
[Drawing 7]



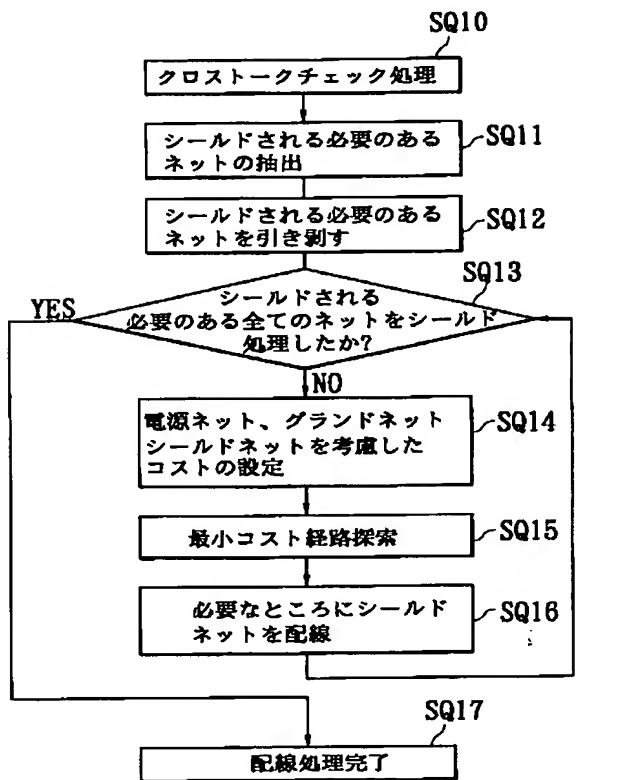
[Drawing 8]



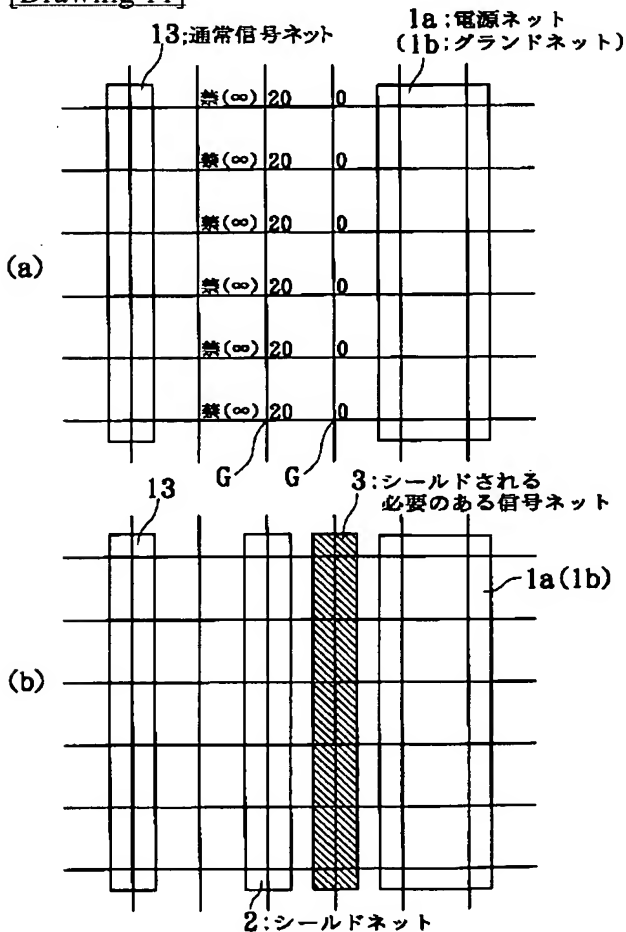
[Drawing 9]



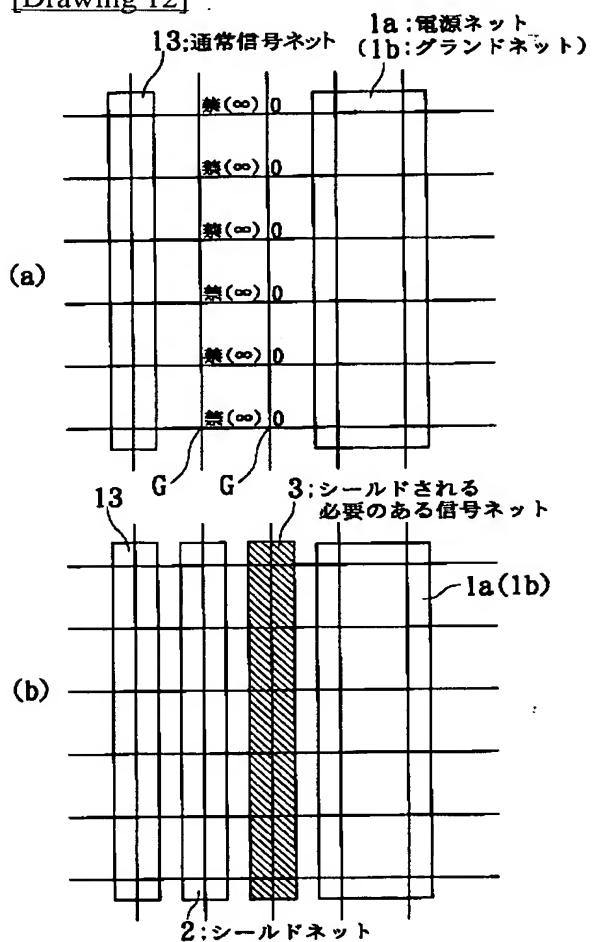
[Drawing 10]



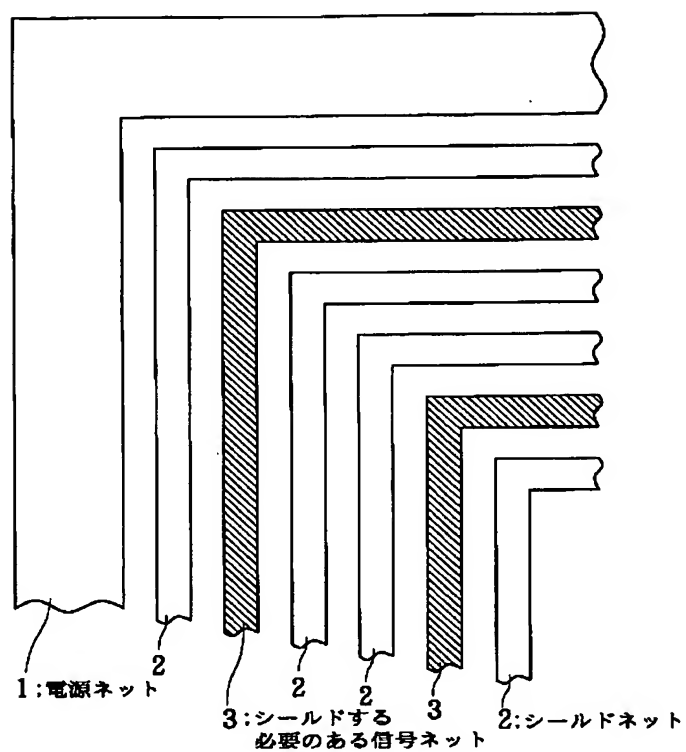
[Drawing 11]



[Drawing 12]



[Drawing 15]



[Translation done.]